

AMENDMENTS TO THE CLAIMS

This listing of the claims will replace all prior versions thereof.

1. (Currently Amended) A method for process monitoring, comprising:

operating a beam of charged particles directed towards a sample at an energy in a negative charging domain of a second layer that is formed over an at least partially conductive first layer of the sample thereby to pre-charge the second layer of the sample, the second layer having contact openings therein and the pre-charging being in a vicinity of at least some of the contact openings;

directing ~~a~~ the beam of charged particles ~~(i)~~ towards ~~a~~ the sample having a first layer that is at least partially conductive and a second layer formed over the first layer and having contact openings therein, and ~~(ii)~~ along a beam axis that is oriented at a tilt angle from a normal to a surface of the sample, the tilt angle being greater than an arctangent of an aspect ratio of the contact openings, said aspect ratio being a ratio of a depth to a diameter of an individual one of the contact openings, so as to irradiate ~~side walls of one or more of the contact openings, but not bottoms thereof,~~ in each of a plurality of locations distributed over at least a region of the sample;

creating, from measurements of (i) a specimen current flowing through the first layer in response to irradiation of the ~~side walls of the~~ one or more of the contact openings at each of the plurality of locations and (ii) a secondary electron current emitted from the sample responsive to the beam of charged particles, a map of at least the region of the sample indicating the specimen current measured in response to the irradiation at the plurality of the locations; and

classifying, using the map of the specimen current, anomalies in a process used to create the contact openings.

2. (Previously Presented) The method according to claim 1, wherein creating the map comprises mapping the secondary electron current together with the specimen current.

3. (Cancelled)
4. (Previously Presented) The method according to claim 1, wherein classifying anomalies comprises assessing, based on the map, at least one of a characteristic depth and a characteristic width of the contact openings at each of the plurality of locations.
5. (Previously Presented) The method according to claim 1, wherein classifying anomalies comprises assessing, based on the map, non-uniformities in the process used to create the contact openings.
6. (Original) The method according to claim 5, wherein assessing the non-uniformities comprises assessing variations over the region of the sample.
7. (Original) The method according to claim 5, wherein assessing the non-uniformities comprises assessing variations between different, first and second samples.
8. (Previously Presented) The method according to claim 5, and comprising applying corrective action to the process responsively to classifying the anomalies.
9. (Previously Presented) The method according to claim 1, wherein classifying anomalies comprises assessing, based on the map, an alignment between the contact openings in the second layer and a structure in the first layer.
10. (Original) The method according to claim 1, wherein the sample comprises a semiconductor wafer.
11. (Original) The method according to claim 10, wherein at least some of the locations are located on different dies of the wafer.

12. (Original) The method according to claim 1, wherein directing the beam of charged particles comprises selecting the locations to irradiate such that the one or more of the contact openings in each location among the plurality of locations are characteristic of the contact openings in a respective area of the location.

13. (Original) The method according to claim 1, wherein at least one of the contact openings is a contact hole.

14. (Original) The method according to claim 1, wherein at least one of the contact openings is a trench.

15. (Cancelled)

16. (Previously Presented) The method according to claim 1, wherein classifying anomalies comprises assessing, based on the map, whether a contaminant residue is present within the contact openings.

17. (Cancelled)

18. (Currently Amended) Apparatus for testing a sample comprising:

a particle beam source adapted to direct a beam of charged particles towards a sample at an energy in a negative charging domain of a second layer that is formed over an at least partially conductive first layer of the sample thereby to pre-charge the second layer of the sample, the second layer having contact openings therein and the pre-charging being in a vicinity of at least some of the contact openings, and to thereafter direct ~~a~~ the beam of charged particles ~~(i)~~ towards ~~a~~ the sample ~~having a first layer that is at least partly conductive and a second layer formed over the first layer and having contact openings therein, and (ii)~~ along a beam axis that is oriented at a tilt angle from a normal to a surface of the sample, the tilt angle being greater than an arctangent of an

aspect ratio of the contact openings, said aspect ratio being a ratio of a depth to a diameter of an individual one of the contact openings, so as to irradiate side walls of one or more of the contact openings, but not bottoms thereof, in each of a plurality of locations distributed over at least a region of the sample; ~~angle from a normal to a surface of the sample;~~

a current measuring device adapted to measure a specimen current flowing through the first layer in response to irradiation of the side walls of the one or more of the contact openings at each of the plurality of locations;

a secondary electron detector adapted to measure a secondary electron current emitted from the sample responsive to the beam of charged particles;

a controller adapted to create, from measurements of the specimen current and the secondary electron current, a map of at least the region of the sample indicating the specimen current measured in response to the irradiation at the plurality of locations; and

a workstation adapted to permit classification, using the map of the specimen current, of anomalies in a process used to create the contact openings.

19 - 20. (Cancelled)

21. (Original) The apparatus according to claim 18, wherein the map is indicative of at least one of a characteristic depth and a characteristic width of the contact openings at each of the plurality of locations.

22. (Original) The apparatus according to claim 18, wherein the map is indicative of non-uniformities in a process used to create the contact openings.

23. (Original) The apparatus according to claim 22, wherein the non-uniformities comprise variations over the region of the sample.

24. (Original) The apparatus according to claim 22, wherein the non-uniformities comprise variations between different, first and second samples.
25. (Previously Presented) The apparatus according to claim 22, wherein the controller is adapted to apply corrective action to the process responsively to classification of the anomalies.
26. (Original) The apparatus according to claim 18, wherein the map is indicative of an alignment between the contact openings in the second layer and a structure in the first layer.
27. (Original) The apparatus according to claim 18, wherein the sample comprises a semiconductor wafer.
28. (Original) The apparatus according to claim 27, wherein at least some of the locations are located on different dies of the wafer.
29. (Original) The apparatus according to claim 18, wherein the locations to be irradiated are selected such that the one or more of the contact openings in each location among the plurality of locations are characteristic of the contact openings in a respective area of the location.
30. (Original) The apparatus according to claim 18, wherein at least one of the contact openings is a contact hole.
31. (Original) The apparatus according to claim 18, wherein at least one of the contact openings is a trench.
32. (Cancelled)

33. (Original) The apparatus according to claim 18, wherein the controller is adapted to assess, based on the specimen current, whether a contaminant residue is present within the contact openings.

34 - 38. (Cancelled)